

(12) **UK Patent Application** (19) **GB** (11) **2 159 567 A**

(43) Application published 4 Dec 1985

(21) Application No **8510383**

(22) Date of filing **24 Apr 1985**

(30) Priority data

(31) **8410564**

(32) **25 Apr 1984**

(33) **GB**

(51) INT CL<sup>4</sup>

**E05B 61/00**

(52) Domestic classification

**E2A 103 136 401 409 420 421 504 505 507 510 BC**

**U1S 1212 1715 1856 E2A**

(56) Documents cited

**GB A 2016576**

**GB 1529789**

**GB 0963444**

**GB 1577210**

**GB 1419021**

**US 3939679**

(58) Field of search

**E2A**

(71) Applicant

**Kenneth Ivor Jordan,**

**The Old Manse, Harston, Cambridgeshire CB2 5QB**

(72) Inventor

**Kenneth Ivor Jordan**

(74) Agent and/or Address for Service

**Urquhart-Dykes and Lord,**

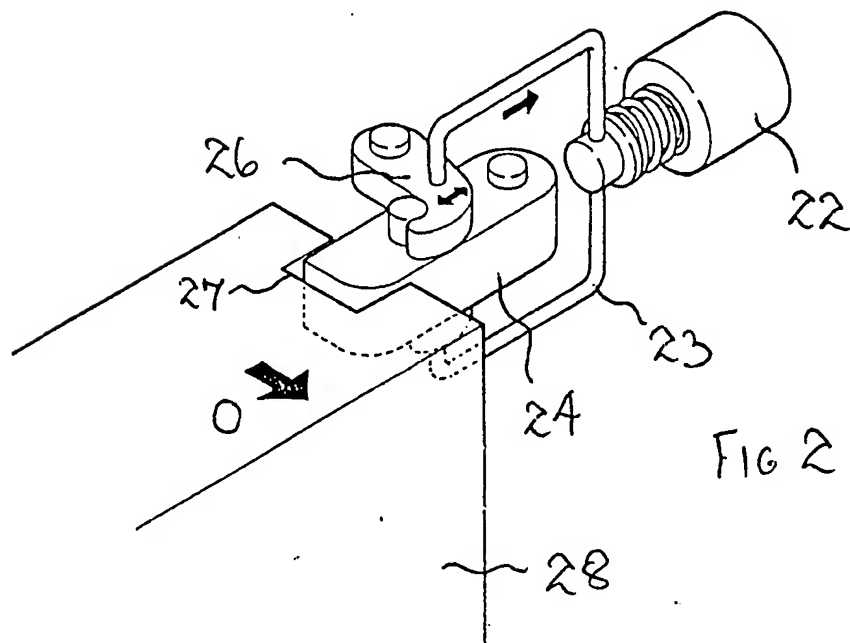
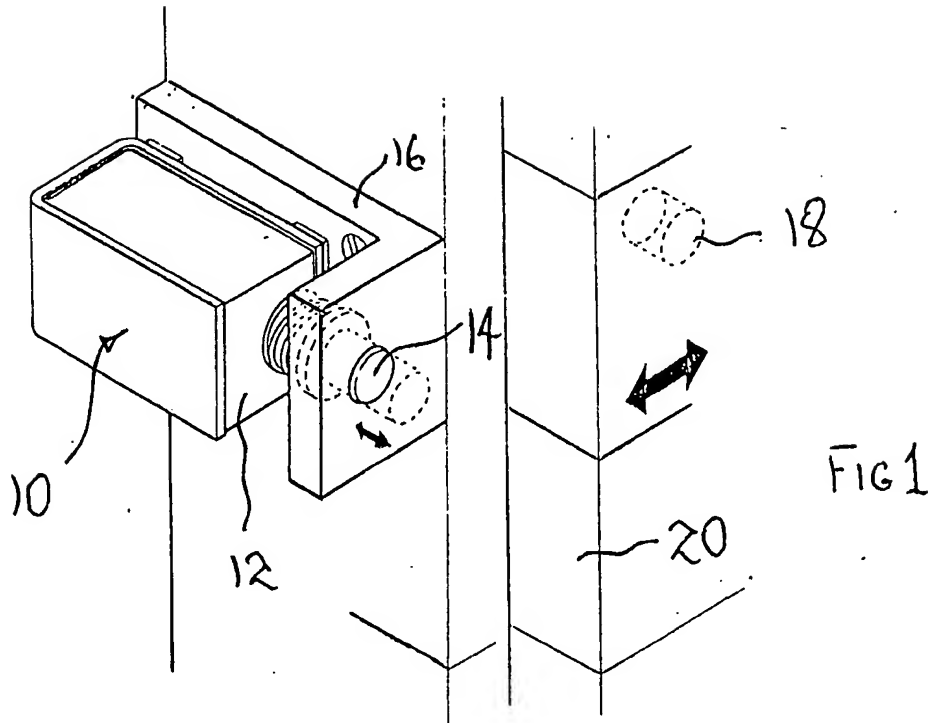
**Trinity Court, Trinity Street, Priestgate, Peterborough**

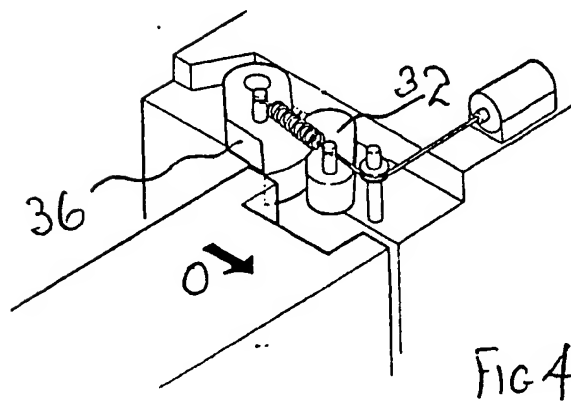
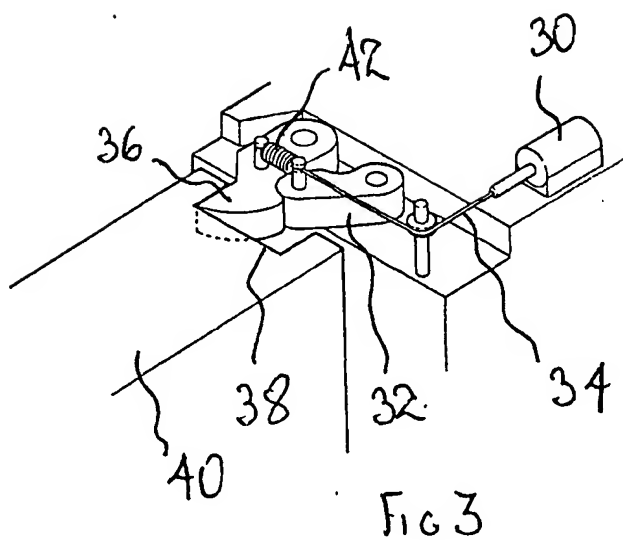
**PE1 1DA, Cambs**

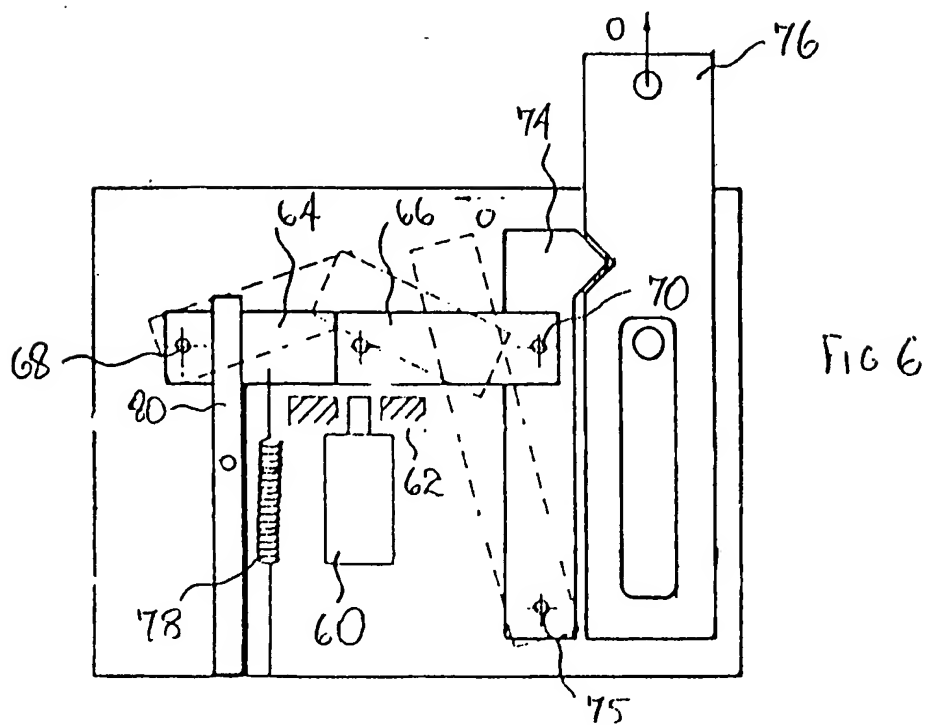
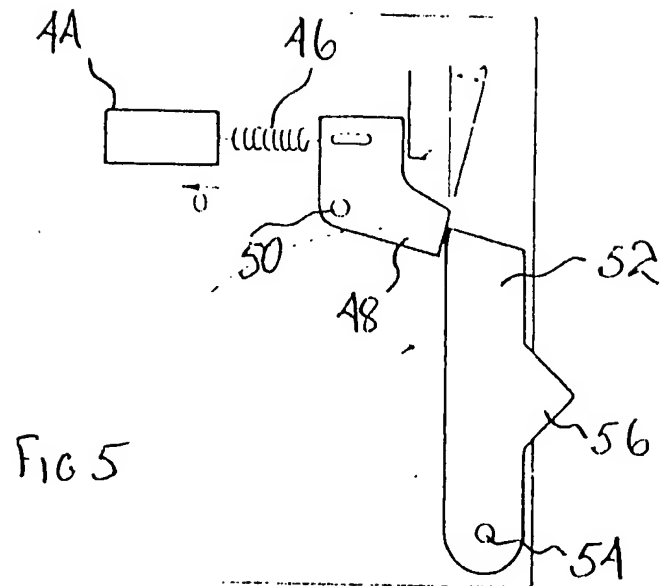
(54) **Security apparatus for controlling locks or latches**

(57) An electronic transmitter or key is arranged to transmit coded infra-red signals to a remote receiver or lock which processes the signals and actuates a solenoid to release a mechanical locking mechanism. The key comprises a keypad for the entry of an unlocking combination of digits which are coded prior to transmission. The security device is applicable to road vehicles, buildings, doors, windows and storage receptacles.

**GB 2 159 567 A**







## SPECIFICATION

### Security devices

- 5 This invention relates to security device such as locks, latches and the like. The invention is particularly, but not exclusively, applicable to security devices and locks and the like for road vehicles, buildings, doors, windows and
- 10 for storage receptacles such as filing cabinets.

- Conventional security devices such as those operated by mechanical keys and the like suffer from various shortcomings including the fact that the key used for operating such a
- 15 system can be readily copied and the keyhole provides a means for gaining access to and unlocking the device without the use of an authorised key.

- An object of the present invention is to
- 20 provide a security device offering improvement in relation to presently available security devices and systems.

- According to the invention there is provided a security device and a method of operating
- 25 same as defined in the accompanying claims.

- In an embodiment described below, a security device or lock or latch is actuatable to be changed from a secure to a released condition by remote actuating means. The actuating
- 30 means may also actuate the lock from a position local thereto. The actuating means may comprise transmitting means arranged to transmit a signal to be received by receiving means adapted to change the security device
- 35 from its secure to its released condition.

- The transmitting means may transmit any suitable electro-magnetic signal such as an infra-red or an optical beam. The receiving
- 40 means may be arranged to receive any suitable electro-magnetic signal from the transmitting means, according to the frequency of the latter. The receiving means may be passive, semi-active or active and comprise a digital system arranged to receive a combination of frequencies. The transmitting means
- 45 and receive any desired format of signal, including coded signals. The signal or transmission receiving means may be adapted to send and required to unlock any given
- 50 security device can be arranged to differ from those of all others. This could be achieved by, for example, providing a system corresponding somewhat with that of a combination lock whereby the transmitting means transmits a
- 55 signal according to a combination or code punched into it by the user, each digit of the code or combination producing a signal which is received by the receiving means.

- The security of transmissions between the
- 60 transmitting means (or key) and the receiving means (or lock) may be protected by suitable algorithm techniques using a stream cypher and custom or semi-custom integrated circuit implementation, together with a cryptographic
- 65 key of sufficient bits to make an attack on the

data impractical.

- In the case of secret and financial and defence applications which demand the highest levels of resistance to penetration and
- 70 transmission errors, the security of the device may be enhanced by introducing additional features such as a bidirectional transmit/receive system, and/or randomisation of sequential cryptographic keys, and/or the use of transponding locks or other security devices.
- 75 By the term "transponding" as used in the above context is meant by the ability of a system or apparatus to report on its status, such as locked or unlocked etc.

- In some applications, the transmitter or impulse may be attached to the security device or lock. In other situations of remote control, for example the central locking of the doors and windows of a house, office or factory, the
- 80 transmitter or impulser may be separate from the security device itself and may be small enough to carry on a car key-ring or in a pocket or a handbag.

- The security device or lock may comprise a sliding bolt in the manner of a piston in a cylinder. The piston may be attached to a quadrant which is free to move on its own axis, clockwise and anti-clockwise. When the quadrant (to which the latch is attached) is
- 90 moved clockwise, the piston makes the cylinder traverse past its own dead centre and it is then locked mechanically so that its transverse cannot be reversed until the lock is released.

- The invention also provides a security device or lock or latch, and a method of operating same, not limited by the features of the claims hereto but comprising any novel feature or novel combination of features disclosed herein.
- 100

- Referring now more specifically to the embodiments described below, the apparatus comprises two principal elements, an electronically controlled lock, and a hand-held electronic transmitter (referred to as a key), the
- 105 lock comprising a sliding bolt which locks automatically when the door or other object to which it is attached is closed. The lock has no mechanical key and may only be opened electronically. An electronic receiver in the
- 110 lock decodes a transmitted combination code from the key, and if this combination matches that stored in the lock memory, an actuator is operated which unlocks the mechanism.

- The key comprises a transmitter employing
- 120 infrared or radio waves or some other non-physical connection, which is used to transmit a predetermined electronic combination code which is entered by the user onto a keypad on the transmitter.

- Examples of the application of the invention include the following. In road vehicles the apparatus may be used to lock the driving seat in a forward position to prevent the vehicle being driven by a potential thief. This
- 125 would replace the conventional steering lock.
- 130

In domestic, industrial and commercial properties, the apparatus may be fitted to all doors and windows whereby these can be locked in one operation from a remote location.

- 5 In high security filing systems, the apparatus may provide central locking of all filing cabinets and desk drawers in an office. A facility for the remote monitoring of the state of locks in an office e.g. open or shut, from a  
10 remote security location within the building may be provided.

- In commercial goods vehicles the apparatus may be fitted to the rear doors of a vehicle so that the latter may only be opened by some-  
15 one who is in possession of the combination code at the end of the journey, and the doors could (if so desired) not be opened by the driver.

- Embodiments of the invention will now be described by way of example with reference to the accompanying drawings in which:

*Figure 1* shows a simple door bolt type locking mechanism;

- Figure 2* shows a ratchet type lockig mechanism;  
25 nism;

*Figure 3 and Figure 4* show a ratchet and detent door locking mechanism in its locked and opening conditions respectively;

- Figure 5* shows, diagrammatically, a solenoid-released latch mechanism; and  
30 released latch mechanism; and

*Figure 6* shows an automatic relatching mechanism using a four bar toggle linkage.

- As shown in Fig. 1, a locking mechanism 10 comprises a solenoid 12 operating a bolt 14 slidable through an aperture in a bracket 16 to be received in a complementary recess 18 formed in a sliding door 20. This arrangement has the merit of particular simplicity.

- In the locking mechanism of Fig. 2 a solenoid-operated plunger 22 acts through a link 23 to operate a bolt 24 via a pair of level arms 26, whereby the bolt is withdrawn from a recess 27 in a door 28 so that the latter can be opened in the direction of arrow O.

- 45 In the embodiment of Figs. 3 and 4, a solenoid 30 acts on a lever 32 through a flexible wire 34 to withdraw the lever 32 from the locked Fig. 3 position to the released Fig. 4 position, whereby a ratchet or latch member 36 which is received in a recess 38 formed in a door 40 can be pushed out of the way and the door opened in the direction of arrow O.

- Solenoid 30 acts against a coiled tension spring 42 which returns the system to the Fig. 3 condition, when released.  
55 Fig. 3 condition, when released.

- Fig. 5 shows a modified latch mechanism in which a solenoid 44 acts through a tension spring 46 on a lever 48 pivoted at 50, whereby the lever can release a latch member 52 pivoted at 54 and having a locking bar 56.  
60 52 pivoted at 54 and having a locking bar 56.

- In the preferred embodiment of Fig. 6, a solenoid 60 acts between a pair of stops 62 approximately centrally against a pair of links 64, 66 pivoted, respectively, at 68 and 70 so  
65 64, 66 pivoted, respectively, at 68 and 70 so

as to move the links to their indicated dotted line positions for release. In their full line positions, the links hold a latch member 74 which is pivoted at 75 in its locking position in which it may engage in a recess formed in a sliding locking bolt 76.

A spring 78 acts on lever 64 to return it to its full line position.

- The toggle linkage provided by the two links, which tend to line-up in their straight line position has the advantage that a very small force from the solenoid 60 is sufficient to release the links, but the latter hold the latching member 74 in its latching position with a very high mechanical advantage.  
75 links, which tend to line-up in their straight line position has the advantage that a very small force from the solenoid 60 is sufficient to release the links, but the latter hold the latching member 74 in its latching position  
80 with a very high mechanical advantage.

A stop 80 defines the in-line position of the links 64, 66. The directions of opening movement of the members 74, 76 are indicated by arrows O.

- 85 In the embodiments of Figs. 1 to 6, the solenoids are operable to release the locking or latching mechanisms under the control of an actuating means or key to be described below.

- The system provided for controlling the solenoids of the locking/latching mechanisms described above comprises a transmitter or key capable of sending a transmission to a receiver or lock. On receipt of a suitable transmission or signal, the lock then either directly operates the solenoid to lock or unlock the mechanism or else signals a slave lock to perform this function. In addition, monitoring apparatus may be provided which communicates with the lock to report on the status of the latter i.e. as to whether it is in the locked or unlocked condition.  
90 The system provided for controlling the solenoids of the locking/latching mechanisms described above comprises a transmitter or key capable of sending a transmission to a receiver or lock. On receipt of a suitable transmission or signal, the lock then either directly operates the solenoid to lock or unlock the mechanism or else signals a slave lock to perform this function. In addition, monitoring apparatus may be provided which communicates with the lock to report on the status of the latter i.e. as to whether it is in the locked or unlocked condition.

For communication between the key and the lock infra-red signals are preferred although it would be possible to employ radio signals, ultrasonic beams, or visible light.

- Where a slave lock is employed, communication between the master lock and the slave lock may employ the same signal-carrying media as between key and master lock, with the additional possibility of a physical wire link.  
105 Where a slave lock is employed, communication between the master lock and the slave lock may employ the same signal-carrying media as between key and master lock, with the additional possibility of a physical wire link.

For monitoring purposes between the lock and the monitor, the above-mentioned signal-carrying media may be employed or a ring main or a telephone line, or indeed a local area network. The preferred method both for monitoring and for signalling to a slave lock employs radio frequency transmission.

- Turning now to the signal transmission between the key and the lock or master lock, for reasons of portability, the key is battery powered. The infra-red signal transmission is coded and employs a sufficiently large number of digits in the combination to make the probability of guessing the combination low. Furthermore, the transmitted sequence of digits is encrypted in a different way each time it is transmitted so that a potential attacker who manages to monitor the transmission  
120 Turning now to the signal transmission between the key and the lock or master lock, for reasons of portability, the key is battery powered. The infra-red signal transmission is coded and employs a sufficiently large number of digits in the combination to make the probability of guessing the combination low. Furthermore, the transmitted sequence of digits is encrypted in a different way each time it is transmitted so that a potential attacker who manages to monitor the transmission  
125 who manages to monitor the transmission  
130 who manages to monitor the transmission

cannot simply replay signals received, and thereby open the lock.

The key apparatus comprises a simple numerical key board with a small number of additional functions, an encryption circuit, a transmitter wave form generating circuit, an infra-red light emitting diode (LED) drive, and an indicator LED drive. The apparatus itself may be constructed so as to be no larger than a pocket calculator.

The electronic circuit comprises a semi-custom gate array device, estimated to require 900 to 1200 gates, and performing the functions of keyboard scan and decode, automatic circuit de-energisation after use, encryption, transmitter wave form generation and driving the two LEDs.

The apparatus operates so that pressing any button on the keyboard will activate the circuit and generate a unique sequence of digits. This sequence is combined with the output from a pseudo random number generator to produce an encoded sequence. The encoded signal is then used to drive an output to the infra-red LEDs. The indicator LED is also illuminated for so long as the button is held down. Once the button has been released, and the transmission is completed, the circuit is shut down.

Turning now to the lock circuit, this employs a four-bit micro-computer and a DIGILIN gate array performing the functions of detection and pre-amplification of infra-red signals, low battery voltage indication, micro-computer shut down, decryption, and direct drive to the actuator. Further functions of the logic array include low battery LED drive and acceptance of encryption code from an external EERON.

The functions performed by the micro-computer includes system control and sequencing, storage of COMBINATION in EERON, timing, signal reception and comparison, and on/off control of the actuator such as the solenoid. In systems employing slave locks, and monitoring, there would be provided in addition the necessary monitor link, the master to slave lock line and the radio transmitter/receiver circuits therefore.

Operation of the system will now be described.

When power is applied to the lock it will be in an "enter code" state. At the front of the lock, an LED flashes continuously indicating that the combination should be entered. The user points the key at the lock and presses the predetermined sequence of digits on the keypad.

The depression of each key in the sequence causes the transmission of a coded infra-red signal between the key and the lock, this signal being received, stored and processed. If processing of the signal results in identification of the received signal as originating from an authorised user, the lock mechanism responds by signalling the solenoid to open the

lock. Use of an incorrect digit necessitates commencing the unlocking sequence afresh. Repetition of the unlocking sequence with failure three times in a row introduces a time delay before the apparatus will respond again. These and many other features may be incorporated to prevent unauthorised operation of the lock mechanism.

Many modifications may be made in the embodiments described above while remaining within the scope of the invention, including modification of the type of signalling system and signals used, details of the mechanical locking arrangement, and of course the electronic circuitry of the transmitting and receiving devices for implementing the above-described functions are matters of continuous design change and improvement.

It will be noted that the security device described above does not depend on a mechanical key or unlocking purposes and therefore cannot be "picked".

In the application of the security device to road vehicles such as cars, lorries, buses, vans, motor cycles and any other vehicle having a conventional driving seat, the security device can be incorporated into the seat so that part at least of the latter can be locked forward against the steering wheel or handle bars so that access to a proper driving position is denied.

In motor cycles, the whole or part of the seat will be raised and locked at an angle of 45 degrees from its normal driving position, thereby making it impossible to drive the machine. The seat can be locked in riding or parked conditions.

For locking purposes, all that is required is to pivot the seat to its non-driving secure position whereupon it becomes mechanically locked in that position and can only be unlocked by use of the transmitter to send a signal or impulse, coded or otherwise, to the receiving device which thereby unlocks the seat and allows the latter to be returned to its normal driving position.

In the application of the invention to all domestic industrial and commercial properties, the security device is fitted to all doors and windows as required, either in individual isolation or in a circuit. When fitted in a circuit (which may be operated by battery, mains or a combination of both) the doors and windows will all be locked centrally in one operation, as in a motor car. In that manner the impulser or transmitter need not be on the house or building, it could for instance be operated from a remote control position in, say, the garden or garage. Several locks could be linked to a modem in an office and then signals transmitted via the telephone network to a remote listening and control station elsewhere in the building, or anywhere else, by use of a space satellite. In addition, it will be possible to combine access control with fire

and intrusion systems.

- In application of the invention to high security risk filing systems, the security device can be fitted to filing cabinets and desks and
- 5 when the latter are shut they are also locked in a mechanical manner at the same time. All the filing cabinets in a office can be locked in one operation in unison by the closing and locking of the door of the room in which they
- 10 are, this feature again providing central locking. The unlocking operation is performed as described above by means of the transmitter device. Modem links and satellite links apply here equally also.
- 15 In application to commercial goods vehicles, the security device could be fitted to the rear doors of a lorry. Closing of the doors produces locking. Unlocking is performed by the transmitter device. That device need not
- 20 be carried by the driver, so that only when the vehicle arrives at its proper destination can the doors be unlocked.

- It will be noted that in the above embodiments the correct digital combination (known
- 25 only to the authorised user) must be entered into the transmitter or key before it will open the lock, whereas existing electronic cards need by their nature to have the combination permanently imprinted in or on them. That
- 30 makes them just as vulnerable as a conventional key should they be lost or used by an unauthorised user before the reader computer can be informed to void the card.

### 35 CLAIMS

1. A security device, such as a lock or latch, which is actuable to be changed from a secure to a released condition by actuating means comprising signal transmission and receiving apparatus adapted to communicate

40 without mechanical connection whereby a signal received from the transmission apparatus changes the device from its secure to its released condition.

2. A device according to claim 1 wherein said signal transmission and receiving apparatus is adapted to send and receive electromagnetic signals.
3. A device according to claim 2 wherein

50 said signals are infra-red signals.

4. A device according to any one of the preceding claims wherein said signals are coded prior to transmission.
5. A device according to claim 4 wherein

55 said signal transmission apparatus is adapted to code said signals by an encryption process comprising a randomization step.
- 6. A device according to any one of the preceding claims wherein said signal receiving

60 apparatus is adapted to actuate the security device by means of a solenoid.

- 7. A device according to any one of the preceding claims comprising a lock or latch member positionable by a toggle mechanism

65 and having an actuator to release the toggle

mechanism.

8. A device according to claim 7 wherein said toggle mechanism comprises a pair of pivoted links normally held in-line to maintain
- 70 a latch member in its latching condition, and said actuator being arranged to act generally centrally between said links.

9. A security device such as a lock or latch substantially as described herein with
- 75 reference to the accompanying drawings.

10. A method of operating a security device such as a lock or latch comprising the step of providing a device according to claim 1 and further comprising the step of employ-
- 80 ing said signal transmission and receiving apparatus to communicate a signal whereby the security device is changed from its secure to its released condition.

Printed in the United Kingdom for  
Her Majesty's Stationery Office, Dd 8818935, 1985, 4235.  
Published at The Patent Office, 25 Southampton Buildings,  
London, WC2A 1AY, from which copies may be obtained.